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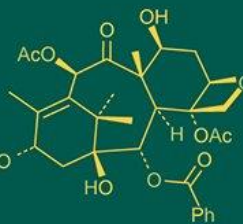
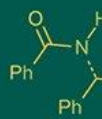
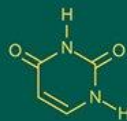
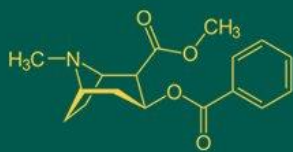
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Incidence of canine chronic kidney disease and its associated risk factors in and around Bhubaneswar, Odisha

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Abstract

Chronic kidney disease (CKD) is a highly prevalent renal disease of geriatric dogs leading to decreased survivability that is manageable with renoprotective therapy. The objective of this research work is to study prospective incidence of canine chronic kidney disease based on different parameters such as breed, age, and change in lifestyle of pet dogs. The incidence was recorded highest in German shepherd followed by Labrador retriever among different breeds of dogs. Prevalence was observed more in dogs over 7 years and male dogs were found more affected as compare to female dogs. Risk factors associated with dogs are maintenance with lifetime high protein pet food and presence of concurrent disease that depicts positive correlation with incidence of CKD in dogs. Studies in Teaching Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar and different hospitals of Bhubaneswar suggested increased incidence of canine chronic kidney disease in German shepherd dogs.

Keywords: Bhubaneswar, breed, chronic kidney disease, dogs, prevalence

Introduction

In chronic kidney disease (CKD), there is a sustained decrease in renal function, especially in cases which are 3 months old or more. It is a multifaceted disease and a disease of clinical importance causing increased morbidity and mortality in dogs. Acute injury of renal cell by calculi, pyelonephritis and nephrotoxic substances are responsible for the development of this disease; this is attributed to the fact that renal cell are incapable of regenerating themselves. Chronic renal failure is one of the common causes in old aged dogs. Clinically it manifests as anorexia, thin body condition, weight loss, dehydration, poor hair coat, increased water intake and urine output that progresses to oligouria because of decreased glomerular filtration rate and consequently, there is diminution of homeostatic function of the body (Polzin *et al.*, 2005 and Kumar *et al.*, 2011)^[32, 20]. Ulceration of oral mucosa, dental plaque and halitosis are the most recognizable early warning signs of incipient chronic kidney disease (DeBowes *et al.*, 1996)^[6]. The 10% of normal renal function presents with nervous sign such as uremic encephalopathy indicating terminal stage of disease. This study was undertaken to record the prevalence of chronic kidney disease among the population of dogs in Bhubaneswar from 2019 to 2020.

Materials and Methods**History and Clinical Examination**

A total of 370 dogs were screened at the Teaching Veterinary Clinical Complex (TVCC), College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar, Govt. veterinary hospital and other private pet clinics of Odisha during period of 2019-2020. Complete medical history from dog's owner with respect of breed, age, sex, type of diet offered to the dogs, presence of concurrent illness with following clinical criteria such as anorexia, vomiting, lethargy, halitosis, polydipsia, polyuria, loss of weight, physical examination performed and examination of urine for protein were collected.

Each patient was thoroughly examined with respect to their health status, associated risk factors were determined, and data and information pertaining to diagnosis and therapeutic management of canine chronic kidney disease were recorded.

Dietary modification is one of important factors that has been suggested to contribute to the increased incidence of CKD; especially diets rich in high phosphorus and potassium depleted acidifying diet causing hypokalemia are responsible for development of CKD in healthy dogs (Elliott *et al.*, 2006 and Polzin *et al.*, 2006) [9, 32]. The established rules for recommendations regarding veterinary nephrology classify the scheme proposed for veterinary clinical nutrition (Roudebush *et al.*, 2004) [36]. Predisposing factors of this health problem are diabetes mellitus, cystitis, pyometra and other diseases (Jacob *et al.*, 2005) [15]. Proteinuria contributes to the progression of disease and the condition occur primary due to malnutrition and loss of body condition (King *et al.*, 2007 and Kovesdy *et al.*, 2013) [18, 19].

Urine analysis

Urine collected by urethral catheterization using sterile flexible catheter no. 8 or 10 sample is collected with help of sterile syringe into sterile urine collection container and immediately processed for routine analysis. Urinalysis was done by using dipstick analysis (microidd mission manufacturer, Acon), where the test strip is dipped in to urine then immediately removed and kept horizontally, allowing it to dry (Zatelli *et al.*, 2010) [38]. The samples revealed changes in pH, specific gravity, presence of leukocyte, protein and glucose.

Statistical analysis

Statistical analysis was performed using pearson's chi-squared test and Microsoft Excel Spreadsheet.

Results

Overall incidence rate

22 dogs out of 370 dogs were found positive for dipstick test (Mission urinalysis strips). The overall prevalence rate studied in different dog population was recorded as 5.9%. The study was centered on 13 different breeds that includes purebred and mix bred (Table 1. Fig 1). Among the different breed of dog studied, German shepherd showed significantly higher incidence ($P \leq 0.05$) followed by Labrador retriever. The disease was less significantly prevalent amongst Dachshund cross breed, Spitz and Doberman. Breeds that recorded lower prevalence rate were Pomeranian and Non-Descript breeds. Breeds that recorded no prevalence of CKD were Pug, Chihuahua, Great Dane, Golden retriever and Dalmatian.

Age wise incidence

The overall age of dogs with CKD varied from one to 14 years. The mean age of the 22 dogs was over 7 year old (Table 2). In the present study, maximum number (14) dogs had age more than 8 year of age.

Gender wise incidence

Out of 22 cases diagnosed for CKD in present study, there were 13 male and 9 females. This revealed that male dogs suffered from chronic kidney disease more frequently than female dogs.

Diet wise incidence

In the present study, it is observed that dogs getting diet without consultation from veterinarian which are readily available (6.66%) were more affected with CKD than dog getting home-made diets (4.6%) (Table2). Unfortunately, diets that are fed without proper knowledge and awareness by getting it from shops are too high in phosphorus and protein for pets.

Observed clinical signs in CKD patients

The common clinical signs observed were weakness and anorexia in dogs. One of predominant clinical sign observed is dehydration that occurs due to vomition, diarrhoea and polyurea. Anaemia and renal dysfunction findings are seen as a result of the effect of uremic toxin on medulla. Uremic gastroenteritis, poor hair coat, halitosis, emaciated body, pale conjunctiva mucous membrane, oral ulcer are common findings. Dogs suffering from glomerular hyperfiltration and systemic hypertension have difficulty in concentrating urine. This is implied by high frequency of polyuria, polydipsia and nervous signs (Table 3. Fig.2).

Incidence with concurrent disease

Among the CKD, 7.24% were found affected with concurrent diseases such as gastroenteritis, dehydration, dermatitis, musculoskeletal and reproductive problem, glaucoma, cardiovascular disease. Obesity and diabetes were significantly ($P > 0.05$) more prevalent in CKD than dog which are not apparently sick (1.25%). In CKD, the aetiology is not completely understood and hard to determine. Previous diseases that were clanged to CKD in small animals are glaucoma, ear infection or other ear problems, parasitic problems, cardiovascular disease obesity, diabetes, skin diseases, hip dysplasia, hyperthyroidism, osteodystrophy, gastrointestinal, musculoskeletal and reproductive problem. A higher prevalence of chronic renal failure was observed in non-diabetic male animal.

Urinalysis

Dipstick test is less expensive and lucid to perform. Observed mean protein and pH was 300 mg/dl and 5.58 respectively. This test was performed to screen proteinuria that detected albumin which escaped into the urine.³⁶ Additionally, it studied the alterations found in urine samples such as pH (approx. value equals to 5.7) and urine specific gravity (ranged between 1.015-1.040) which are imperative in diagnosis of renal diseases.³⁷ This study found that 50 % of the positive cases had diluted urine, 40.9% had isothanuria and 9.09% had concentrate urine (Table 4). Proteinuria, pyuria (leucocytes in urine) and glucosuria were found in 18 (81.8%), 12 (54.5%) and 7 (31.8%) the positive cases (Fig.3). Proteinuria have important role as a mediator of renal injury.

Discussion

The prevalence of CKD in canine was found to be 0.5-1% in a study conducted by Polzin (2005) [15]. Chronic Kidney Disease (CKD) is a major cause of morbidity and mortality in dogs. Nephron damage associated with CKD is usually progressive and irreversible. The disease is difficult to be diagnosed and many dogs can live comfortably for years without manifesting any symptoms. Renal disease in the form of congenital and familial are found in some breed of

dogs like German shepherd, Doberman, Boxer, Lhasa Apso and Great Dane (Adams *et al.*, 2004) ^[1]. A few studies reported increased incidence of CKD in German shepherd, Dobermans, Lhasa Apso, Golden Retrievers, Coker Spaniel, Samoyed, and Rottweiler breed of dogs suffering from periodontal disease. Thus, it has been identified as a clinical risk factor for CKD. Breeds that showed less prevalence for CKD in the present study were dog Pug, Chihuahua, Great Dane, Golden retriever and Dalmatian. However, Chen (2010) ^[4] conducted a study in Bangalore and reported the incidence of occurrence of CKD in different breed of dogs population ranging from 3.22 to 22.58%, the Incidence was increased in German Shepherd and Non-Descript (22.58%), followed by Labrador Retrievers (19.35%), Pomeranians (19.35%), Dachshunds (6.45%), Dobermans (6.45%) and Dalmatians (3.2%). In purebred dogs aged below five years, incidence was found very low for CKD as compare to old hybrid dogs that grow readily and stronger as compare to purebred parents. The study was conducted in 60 dogs aged 7.8 ± 0.34 years and is consistent with the finding of Mrudula (2005) ^[24]. In another study, incidence found in adult dog was 20% and maximum 45% dogs aged 10-years old and reported that CKD was not commonly found in dogs aged below six years (Polzin *et al.*, 1989) ^[29]. Girishkumar (2011) ^[13] and Devipriya (2018) ^[7] reported that renal insufficiency (51.33%) was found highest in dogs aged above 8 years (37.67%), while CKD was reported more in dogs above six years age and dog below 2 year were least affected (5.19%). The older age is one of risk factors because renal functions are below normal with aged kidney and are chronically damaged which markedly impact normal physiological performance. The susceptibility of CKD is more in male dogs (59.74%) than female dogs (40.26%) (Polzin *et al.*, 2007) ^[33]. Higher incidence is found in male (66.67%) than female (33.33%) and higher percentage of disease in male might be due to the client's preference to own a male dog (Muralikrishna *et al.*, 2003) ^[25]. Some study observed that small animals may develop renal disorders at low age which progressively develop to juvenile CKD and is likely to be a consequence of familial renal disease (White *et al.*, 2006) ^[37]. A higher prevalence of chronic renal failure was observed in non-diabetic and renal hypertension that causes injury to kidneys, eyes, brain and cardiovascular system. The possible renoprotective role of hormone such as estrogens is evidenced by the lower prevalence of CKD or due to absence of profibrotic effect caused by testosterone (Neugarten *et al.*, 2000) ^[26]. Regarding gender, it is well known that the lead renal failure can be an indication of either autoimmune disease where clumps of antibody are deposited in the kidney and non-immunological event of diseases increased risk for diabetes, hypertension and obesity which together accounted for >70% of end-stage renal disease in canine population (Evan *et al.*, 2005) ^[10]. Dietary formulation associated with development of CKD in dogs particularly are excessive dietary salt, potassium-depleted acidifying feed or high protein content of pet feed which are significant source of phosphorus that lead to progressive development of damaging kidneys (Boswald *et al.*, 2018) ^[3]. High protein diet above the RDA causes secondary nutritional hypoparathyroidism in patients with or without CKD owing to high phosphorus rich diet intake that is responsible for increased fibroblast growth factor and tissue calcification. Malnutrition is the most crucial

complication of CKD and the predisposing factor are weight loss, decreased total plasma protein concentration, anaemia, decreased muscles mass, poor emaciated body condition, etc (Francey *et al.*, 2006) ^[11]. Home-cooked diet may be more suitable and economic for dogs with CKD. The client must get the home-cooked diet from a broad-certified veterinary nutritionist, usually through veterinary teaching hospital nutrition service (Macdougall *et al.*, 1989) ^[22].

It is also clear that multiple risk factors contribute to the gradual decline in kidney function over the time and concurrent diseases could contribute to this process (Jepson *et al.*, 2016) ^[16]. It is reported that presence of previous disease history is significantly associated with CKD; the risk factors related to CKD in small animals are glaucoma, ear infection or other ear problems, parasitic problems, cardiovascular disease obesity, diabetes, skin diseases, hip dysplasia, hyperthyroidism, osteodystrophy, gastrointestinal, musculoskeletal and reproductive problems (Conory *et al.*, 2019). A higher prevalence of chronic renal failure is observed in male dogs suffering from CKD and associated with different diseases like renal calculi, cardiovascular disease and neoplasia (Ling *et al.*, 1998) ^[21]. Retention of nitrogenous substance in the circulation, electrolyte disturbances and dehydration can cause uremic encephalopathy if the cases are complicated by uraemia and hypertension. These findings are similar to the findings of earlier workers (Robinson *et al.*, 1989) ^[35].

An urine analysis is needed to evaluate kidney function: low urine specific gravity (USpG) results into diluted urine that leads to hyposthanuric urine (1.001- 1.007), specific gravity of 1.008-1.015 is an indication of isothanuria, where there is no change in urine excretion and specific gravity more than 1.015 is an indication of concentration of glomerular filtrate (Gruer *et al.*, 2009) ^[14]. Specific gravity of urine that ranges from 1.007 to 1.012 presents isotheruria, which may be a sign of renal disease and reports suggest that 66% of renal damages are associated with isotheruria (renal insufficiency) and presence of azotaemia does not occurs until there is >75% renal damage (renal failure) (Reine *et al.*, 2005). Measurement of increase in level of protein in urine (proteinuria) has been the most significant urinary marker both for increased risk of adverse outcome and for response to renoprotective therapeutic intervention (George *et al.*, 2005) ^[12].

Table 1: Breed wise Incidence of CKD in dogs of Bhubaneswar, Odisha

| Breeds | CKD affected dog / total no. of dogs of that breed presented |
|--------------------|--|
| German shepherd | 7/48 (14.58%) |
| Labrador retriever | 5/56 (8.92%) |
| Cross breed | 2/43 (6.97%) |
| Spitz | 2/48 (4.76%) |
| Dobermann | 2/25 (8%) |
| Pug | 0/14 (0%) |
| Non-Descript | 1/38 (2.63%) |
| Dachshund | 1/14 (7.1%) |
| Chihuahua | 0/5 (0%) |
| Great Dane | 0/10 (0%) |
| Golden retriever | 0/16 (0%) |
| Pomeranian | 1/37 (2.70%) |
| Dalmatian | 0/16 (0%) |

Table 2: Prevalence rate of Chronic kidney disease of dogs based on different risk factor

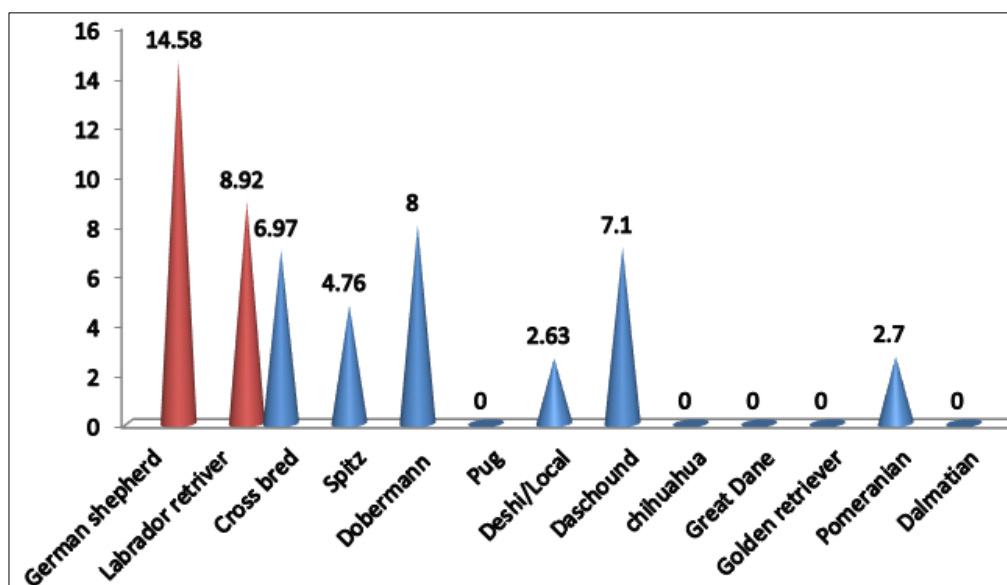
| Risk factor | Variables | Affected dog /total no. dog | Percentage |
|--------------------|------------|-----------------------------|------------|
| Age | < 4 year | 1/42 | 2.3 |
| | 4-8 year | 7/139 | 5.03 |
| | >8 year | 14/189 | 7.40 |
| Sex | Male | 13/192 | 6.77 |
| | Female | 9/178 | 5.05 |
| Diet | Commercial | 16/240 | 6.66 |
| | Home made | 6/129 | 4.61 |
| Concurrent Disease | Present | 21/290 | 7.24 |
| | Absent | 1/80 | 1.25 |

Table 3: Distribution of different Clinical sign and symptoms in dogs with chronic kidney disease.

| Clinical Sign | Observation |
|----------------------------------|-------------|
| Anorexia | 20/22 |
| Vomition | 19/22 |
| Weakness | 21/22 |
| Diarrhoea | 10/22 |
| Pale conjunctiva mucous membrane | 9/22 |
| Oral ulcer | 8/22 |
| Halitosis | 10/22 |
| Emaciated body | 9/22 |
| Polyuria | 7/22 |
| Polydipsia | 3/22 |
| Nervous sign | 2/22 |
| Poor hair coat | 12/22 |

Table 4: Urine Specific Gravity (USG) finding in affected dogs

| Range of Specific Gravity | No. of Animals | observation |
|---------------------------|----------------|-------------|
| 1.007-1.015 | 11 | 50 % |
| 1.016-1.030 | 9 | 40.90% |
| 1.030 & Above | 2 | 9.09% |

**Fig 1:** Incidence rate of Chronic kidney disease in different breeds of dogs

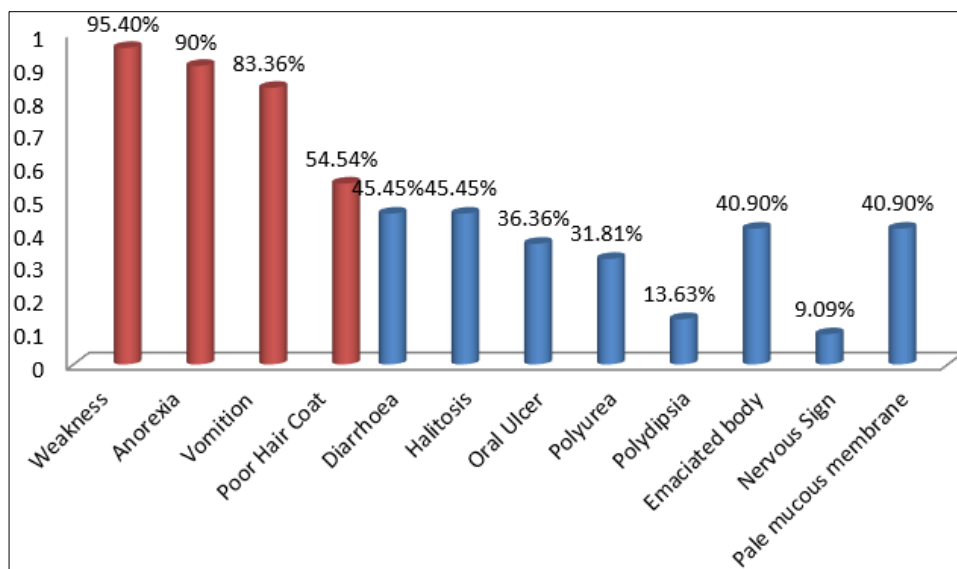


Fig 2: Percentage of different clinical sign in dogs with Chronic kidney disease.

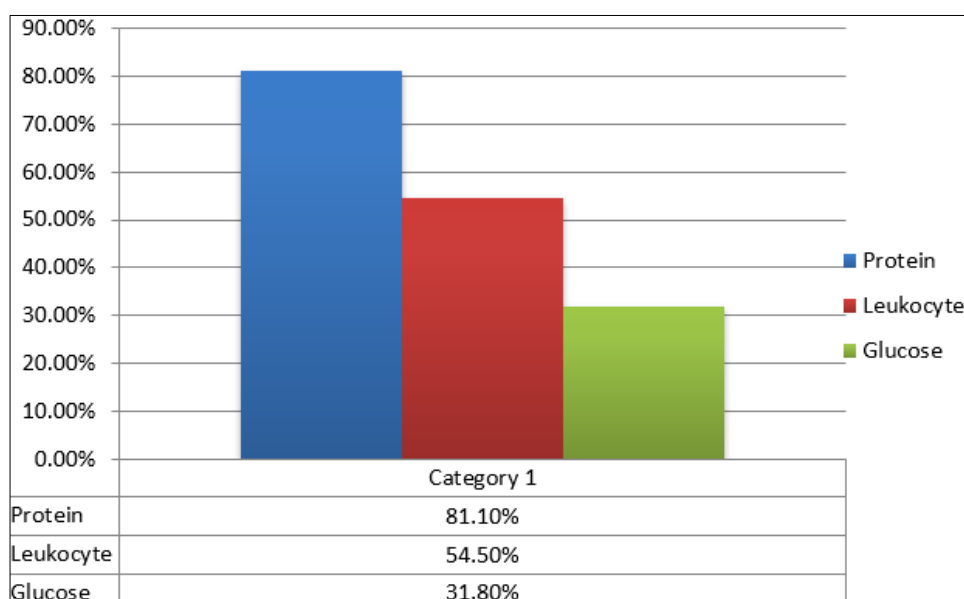


Fig 3: Changes recorded in urine of CKD affected dogs

Majority of old dog always suffer with diabetes mellitus and it is found that hypoglycaemia and persistent glucouria causes renal tubular cell damage, however, presence of leucocytes is an identification of typical inflammatory response. Retention of nitrogenous substance in the circulation, electrolyte disturbances and dehydration can cause uremic encephalopathy if the cases are complicated by uraemia and hypertension. These findings are similar to the findings of earlier workers (McGrotry *et al.*, 2019) [23].

Conclusion

An increase in chronic kidney disease was recorded by examination of various breed of dogs. History, examination of concurrent sign of illness, physical examination and urine analysis of each dog was done. The overall prevalence rate was recorded as 5.9%. Amongst all the affected dogs, prevalence was higher in geriatric age group, males and in presence of concurrent illness. Interventions in lifestyle might also progressively develop CKD. The clinical sign were characteristics of most of cases, but the signs were also suggestive for CKD rather than other disease. Studies in and

around Bhubaneswar suggest that there is an increase in case of canine CKD and decreased case fatality rate.

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Conflict of Interest

Authors declare there is no conflict of interest.

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